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$$\begin{cases} a\boldsymbol{A} + a'\boldsymbol{A}' = b\boldsymbol{B} + b'\boldsymbol{B}' = c\boldsymbol{C} + c'\boldsymbol{C}', \\ \quad a + a' \quad = \quad b + b' \quad = \quad c + c'. \end{cases}$$

Calling the intersections of AB, BC, and CA with the corresponding sides of the other triangle, D, E, and F respectively, and proceeding in the usual way we find[1]

$$(a - b)\boldsymbol{D} = a\boldsymbol{A} - b\boldsymbol{B},$$

$$(b - c)\boldsymbol{E} = b\boldsymbol{B} - c\boldsymbol{C},$$

$$(c - a)\boldsymbol{F} = c\boldsymbol{C} - a\boldsymbol{A}.$$

Adding we have

$$(a - b)\boldsymbol{D} + (b - c)\boldsymbol{E} + (c - a)\boldsymbol{F} = 0.$$

Since the sum of the scalar coefficients of this equation is zero the theorem is proved.

It will be noted that the triangles may be in the same or different planes. Thus the proof is perfectly general.

CEVA'S THEOREM. *If in the triangle ABC the points A', B', and C' are taken on the sides BC, CA, and AB respectively, in such a way that*

$$(AC'/C'B)\cdot(BA'/A'C)\cdot(CB'/B'A) = 1,$$

then the lines AA', BB', and CC' are concurrent.

Proof. Calling the first and second ratios s/r and t/s respectively, the third ratio must be r/t by the hypothesis of the theorem. We have then

$$(s + t)\boldsymbol{A}' = s\boldsymbol{B} + t\boldsymbol{C},$$

$$(t + r)\boldsymbol{B}' = t\boldsymbol{C} + r\boldsymbol{A},$$

$$(r + s)\boldsymbol{C}' = r\boldsymbol{A} + s\boldsymbol{B}.$$

Adding $r\boldsymbol{A}$ to the first equation, $s\boldsymbol{B}$ to the second, and $t\boldsymbol{C}$ to the third, we see that the second members of the resulting equations are equal. Hence

$$(s + t)\boldsymbol{A}' + r\boldsymbol{A} = (t + r)\boldsymbol{B}' + s\boldsymbol{B} = (r + s)\boldsymbol{C}' + t\boldsymbol{C}.$$

The scalar coefficients of these equations satisfy the condition of the theorem, hence the proof is complete.

II. ON A THEOREM IN THE THEORY OF PROBABILITIES.

BY CHARLOTTE DICKSON, American Telephone and Telegraph Co., New York.

In this MONTHLY for October, 1919, Mr. Bancroft H. Brown gives a method for determining the "average number of rolls needed to decide a game of craps."

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[1] We assume here that $a - b$, $b - c$, and $c - a$ are not zero. If any of these differences vanish then some of the corresponding sides are parallel, *i.e.*, intersect at infinity. Our justification for extending the proof to include the points at infinity lies in the fact that the points of intersection remain collinear when one or more of them recede to infinity.

A solution of the same problem by a somewhat simpler method might be of interest.

Let X be the average number of "rolls" needed further to decide a "point." Now we know that it is necessary to make at least one roll; and the probability of this, being certainty, is expressed by unity. If the "point" is not decided at the first roll (the probability of which is p or $1 - q$), the average number of rolls needed is still X. Therefore we arrive at the following equality,

$$X = 1 \times 1 + (1 - q)X$$

from which we find that $X = 1/q$.

This solution and that suggested by Mr. Brown are given by Louis Bachelier in his *Calcul des Probabilités*, volume 1, Paris, 1912, page 11.

III. Concerning the Teaching of Logarithms.

By A. F. Frumveller, Marquette University.

In this Monthly for September, 1919, Professor McClenon brought up the question of introducing logarithms by the historic method of geometric progression; he mentions as an alternative, the complete abandonment of all theory, and the laying down of mechanical rules of thumb for the student until the use of the tables has become automatic. The first or historic method has, it seems, been tried out successfully at the Hyde Park High School, Chicago; Mr. Josef Nyberg explained his proceedure in the October number of this Monthly for 1918, p. 337, but on reading his explanation it would seem as if the lack of directness of this approach would render it unsatisfactory in the hands of teachers less skillful and inspiring than Mr. Nyberg himself.

The late S. A. T. C. arrangement gave the present writer a splendid opportunity of trying out on a large scale the teaching of logarithms to students of average ability; and it so happened that the few days spent in this study afforded the only agreeable interlude in an experience that to most of us was like a nightmare. Our method was this; an equation like $y = x^2$ is written down; we define 2 to be the logarithm of y to the base x, and write $\log_x y = 2$ as the statement of this definition. This we call "translating the exponential equation to the logarithmic form," and the student is drilled at once in making translations of this kind by the dozens, till he can do it automatically; numerical cases like $9 = 3^2$ are next handled orally, with all possible modifications; *e.g.*, if 3 is the log of 8, what base am I using? etc. Many algebras are well supplied with such oral exercises; after a lively quiz of this sort, the students, *all* of them, had the idea of a logarithm firmly fixed in their minds. The rules for operating with logarithms gave no difficulty, since by definition a logarithm is merely another name for an exponent; fractional and negative exponents were then brought in and *translated* into logarithmic form, using always an exponential equation $y = x^{\pm n}$ as a starting point, and then employing numbers in place of y, x, and n, till the idea took root.